

What is claimed is:

1. A porous substrate comprising:  
a support region; and  
5 a porous region on the support region, the porous region being primarily inorganic and having a surface capable of forming a polymer array thereon, the porous region comprising pores of a pore size of about 2 nm - 500 nm, a porosity of about 10 - 90%, and a thickness of about 0.01  $\mu$ m to about 70  $\mu$ m.
- 10 2. The porous substrate of claim 1, wherein the porous region is formed by an additive method.
3. The porous substrate of claim 2 wherein the additive method includes the application of colloidal silica on the support region.
- 15 4. The porous substrate of claim 2 wherein the additive method includes the application of alkoxysilane on the support region.
5. The porous substrate of claim 1 wherein the porous region comprises  
20 silica.
6. The porous substrate of claim 5 wherein the porous region further comprises organic polymer of less than or equal to about 10% mole fraction.
- 25 7. The porous substrate of claim 5, wherein the porous region comprises a plurality of pores, each of the plurality of pores having a size of from about 2 to about 100 nm.

8. The porous substrate of claim 5, wherein the porous region comprises a plurality of pores, each of the plurality of pores having a size of from about 2 to about 50 nm.

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9. The porous substrate of claim 1, wherein the porous region has a porosity of from about 20 -80%.

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10. The porous substrate of claim 1, wherein the porous region has a porosity of from about 50 - 70%.

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11. The porous substrate of claim 5, wherein the porous region comprises a plurality of particles, each of the plurality of particles having a size from about 5 - 500 nm.

12. The porous substrate of claim 5, wherein the porous region comprises a plurality of particles, each of the plurality of particles having a size from about 5 - 200 nm.

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13. The porous substrate of claim 5, wherein the porous region comprises a plurality of particles, each of the plurality of particles having a size from about 70 - 100 nm.

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14. The porous substrate of claim 2 wherein the porous region has a thickness from about 0.1-1 microns.

15. The porous substrate of claim 2, wherein the porous region has a thickness of from about 0.1  $\mu\text{m}$  to about 0.5  $\mu\text{m}$ .

16. The porous substrate of claim 2, wherein the porous region has a thickness of from about 1  $\mu\text{m}$  to about 20  $\mu\text{m}$ .

17. The porous substrate of claim 6, wherein the organic polymer coats silica particles of the porous region.

18. The porous substrate of claim 5, wherein the porous region is silylated with a silyating agent.

19. The porous substrate of claim 18, wherein the silylating agent is selected from the group consisting of N,N-bis(hydroxyethylaminopropyl)triethoxysilane and glycidoxypopyl trimethoxy silane.

20. The porous substrate of claim 2, wherein the porous region is formed by codepositing an organic template material with silica, followed by removing the organic template material.

21. The porous substrate of claim 20 wherein the organic template material comprises particles of about 10-100 nm and the silica comprises particles of about 7-100 nm.

22. The porous substrate of claim 21 wherein an organic template particle size is about equal to a silica particle size.

23. The porous substrate of claim 21 wherein a silica particle size is less than or equal to about 2/3 an organic template particle size.

24. The porous substrate of claim 21 wherein a silica particle size is less than about 10% of an organic template particle size.

25. The porous substrate of claim 20 wherein the organic template material is deposited in a volume ratio to the silica of about 10:1 to 1:10.

26. The porous substrate of claim 20 wherein the organic template material is removed using a baking process at a temperature of above about 150°C.

27. The porous substrate of claim 26 wherein the silica is densified using an annealing process.

28. The porous substrate of claim 20 wherein the porous region has an effective surface area of about 15-40 times a flat substrate with an equivalent two dimensional structure.

29. The porous substrate of claim 1 wherein the porous region is formed by a subtractive method.

30. The porous substrate of claim 20, wherein the organic template polymer is a latex polymer.

31. The porous substrate of claim 29 wherein the porous substrate comprises phase-separable glass, a surface portion of the phase-separable glass being treated to form the porous layer.

5 32. The porous substrate of claim 31 wherein the phase-separable glass comprises a sodium borosilicate glass.

10 33. The porous substrate of claim 32 wherein the sodium borosilicate glass has been annealed and leached to provide the porous layer having a thickness of about 70 microns and comprised of a plurality of pores, at least some of the plurality of pores having a pore size greater than about 1000 Å.

15 34. The porous substrate of claim 29 wherein the porous region has an effective surface area of about 50-400 times a flat substrate with an equivalent two dimensional structure.

35. The substrate of claim 1, further comprising a high density array of nucleic acids immobilized on the surface.

20 36. A porous substrate comprising:  
a support region; and  
a porous region on the support region, said porous region of about 0.1-0.5 microns thick,

25 wherein the porous layer comprises an unsintered matrix formed from at least colloidal silica having a particle size of about 70-100 microns, the unsintered matrix defining at least a plurality of open pores having a pore size of about 10-20 nm, and  
wherein the porous layer has a porosity of about 10-90%.

37. A method of forming a porous substrate, the method comprising:  
 providing a substrate material comprising a surface;  
 dipping the substrate material in a solution including colloidal silica and a  
 5 carrier, the colloidal silica having a particle size of about 12-100 nm; and  
 withdrawing the substrate material to provide an unsintered porous layer having  
 a thickness of about 0.1-1 microns and a porosity of about 10-90% on the substrate  
 material.

10 38. A method of forming a porous substrate, the method comprising:  
 providing a substrate material comprising a surface;  
 applying a solution including colloidal silica and a carrier to the surface of the  
 substrate material, the colloidal silica having a particle size of about 12-100 nm;  
 spinning the substrate material and the applied solution to achieve a spun layer  
 15 on the substrate material; and  
 removing the carrier from the spun layer to provide an unsintered porous layer  
 having a thickness of about 0.1-1 microns and a porosity of about 10-90% on the  
 substrate material.

20 39. A method of forming a porous substrate comprising different monomer  
 sequences, the method comprising:  
 immobilizing different monomer sequences on a porous substrate of claim 1.

25 40. A method of synthesizing polymers on a porous substrate, the method  
 comprising:  
 a) generating a pattern of light and dark areas by selectively irradiating at least a  
 first area of a surface of a porous substrate of claim 1, said surface comprising

immobilized monomers on said surface, said monomers coupled to a photoremovable protective group, without irradiating at least a second area of said surface, to remove said protective group from said monomers in said first area;

b) simultaneously contacting said first area and said second area of said surface with a first monomer to couple said first monomer to said immobilized monomers in said first area, and not in said second area, said first monomer having said photoremovable protective group;

c) generating another pattern of light and dark areas by selectively irradiating with light at least a part of said first area of said surface and at least a part of said second area to remove said protective group in said at least a part of said first area and said at least a part of said second area;

d) simultaneously contacting said first area and said second area of said surface with a second monomer to couple said second monomer to said immobilized monomers in at least a part of said first area and at least a part of said second area; and

e) performing additional irradiating and monomer contacting and coupling steps so that a matrix array of different polymers is formed on said surface, whereby said different polymers have sequences and locations on said surface defined by the patterns of light and dark areas formed during the irradiating steps and the monomers coupled in said contacting steps.

41. The method of claim 40, wherein the monomers are selected from the group consisting of: nucleotides, amino acids, and monosaccharides.

42. The method of claim 40, wherein the substrate has linker molecules on its surface.

43. A method of forming polymers having different monomer sequences on a porous substrate, the method comprising:

providing a porous substrate of claim 1 comprising a linker molecule layer thereon, said linker molecule layer comprising a linker molecule and a protective group;

5 applying a barrier layer overlying said linker molecule layer, said applying step forming selected exposed regions of said linker molecule layer;

exposing said selected exposed regions of said linker molecule layer to a deprotecting agent to remove the protective group; and

coupling selected monomers to form selected polymers on the substrate.

10 44. The method of claim 43, wherein the deprotection agent is in the vapor phase.

45. The method of claim 43, wherein said deprotection agent is an acid.

15 46. The method of claim 45, wherein the acid is selected from a group consisting of trichloroacetic acid, dichloroacetic acid, and HCl.

20 47. The method of claim 43, wherein the monomers are selected from the group consisting of nucleotides, amino acids, and monosaccharides.

48. A method for detecting a nucleic acid sequence, the method comprising:

(a) providing an array of nucleic acids bound to the porous substrate of claim 1;

(b) contacting the array of nucleic acids with at least one labeled nucleic acid comprising a sequence substantially complementary to a nucleic acid of said array, and

25 (c) detecting hybridization at least the labeled complementary nucleic acid to nucleic acids of said array.